



2024/25 Desalinated Water Order Advice

Technical Analysis

March 2024

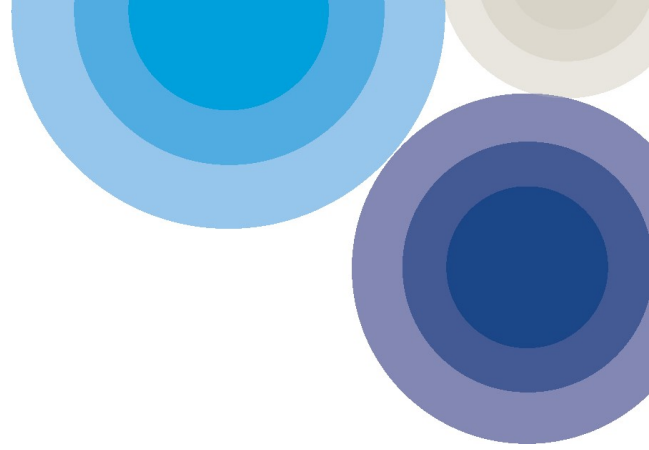


Table of contents

Summary	2
Purpose	3
Context	3
Background	3
Melbourne’s strategic water resource planning	5
Desalinated water order advice	6
Water Outlook zones	6
Principles	8
Technical analysis inputs and assumptions	11
Initial water storage levels	11
Streamflow scenario	12
Demand forecasts	13
Operational considerations	14
Cost information	14
Technical analysis results	14
Other considerations	18
Value of Water in Storage	18
Reservoir spillway flows	19
Climate outlooks	19
Technical outcomes	20
Conclusion	21

Summary

1. Melbourne Water is required to provide desalinated water order advice to the Victorian Government via the Department of Energy, Environment and Climate Action (DEECA) by 1 March every year.
2. This advice is based on an assessment of principles (paragraph 26) and considerations that seek to balance the water security benefits of a desalinated water order volume against the costs and risks given the uncertainty of future inflows into harvesting storages.
3. Melbourne Water worked with the metropolitan water businesses, which hold the Bulk Entitlements to water from the Victorian Desalination Project (VDP), to provide the order advice.
4. The desalinated water order advice provided by Melbourne Water to the Victorian Government was:
 - a. The required annual water volume for the 2024/25 supply period should be 0 GL.
 - b. There are no constrained months in the 2024/25 supply period.
 - c. Non-binding forecasts of 50 GL in 2025/26 and 75 GL in 2026/27 supply periods are appropriate.

Purpose

5. This report provides technical analysis supporting the 2024/25 desalinated water order advice.

Context

Background

6. The Melbourne water supply system includes 10 major reservoirs and associated catchments that are used to harvest and store water, a network of pipelines, pump stations, and tanks that are used to supply water to households and businesses across Melbourne and the surrounding region. The total system storage capacity of the 10 major reservoirs is 1,812 gigalitres¹ (GL). The VDP, located near Wonthaggi, is connected by an 84 kilometre underground transfer pipeline to Cardinia Reservoir in the Melbourne water supply system. The VDP is operated by AquaSure, and can supply up to 150 GL/year, or around one third of Melbourne's current annual water demand. Bulk Entitlements to water produced by the VDP are held by the metropolitan water businesses (Greater Western Water, South East Water and Yarra Valley Water).
7. Melbourne's water storages supply water to the metropolitan water businesses; the regional water businesses (including Barwon Water, Westernport Water, Gippsland Water and South Gippsland Water); for the environment on behalf of the Victorian Environmental Water Holder (VEWH); and Southern Rural Water's irrigation customers.
8. At 1 January 2024, around 62% of the water stored in Melbourne's water supply system was available for greater Melbourne. The rest was held by other water entitlement holders such as regional water businesses, the Victorian Environmental Water Holder (VEWH) and irrigators or is water that is inaccessible under normal operating conditions.
9. During severe drought years such as 2006/07, storage volumes can decline by as much as 20% of total system storage capacity in a 12-month period. As the annual supply capacity of the VDP can only meet a proportion of water demand, during drought periods water security is dependent on the volume of water already accumulated in water storage at the start of these periods.
10. The aim of water supply system planning and operations with both catchment water sources and the VDP is to build and maintain a buffer of water in storage while managing short and long term pricing impacts. A sufficient storage buffer is especially critical during severe drought periods.

¹ 1 gigalitre = 1 billion litres (the equivalent of around 400 Olympic swimming pools). In 2020/21, Melburnians (including those in the former Western Water) used 440 GL of water.

These periods could last for more than a decade, as experienced in the 1997-2009 Millennium Drought. Thomson Reservoir provides around 60% of total system storage capacity and has historically only filled to capacity six times since it was completed in 1984. Thomson Reservoir is a large reservoir relative to its net inflow and while at capacity it provides a 'drought' reserve for Melbourne and the surrounding region against dry streamflow conditions, it can only fill from natural inflow. Mean annual streamflow into Thomson Reservoir is roughly one fifth of its capacity. Operation of the VDP reduces water transfers from Thomson and other reservoirs and therefore is key to enabling the water supply system to manage water volumes from year to year and over extended time frames.

11. Since the VDP was completed in 2012, 455 GL of desalinated water has been delivered from 2017 up to January 2024. This has significantly contributed to the high storage position over 2022 and 2023, with no desalinated water order required in 2023/24.

12. Figure 1 shows historical water storage levels since 2012.

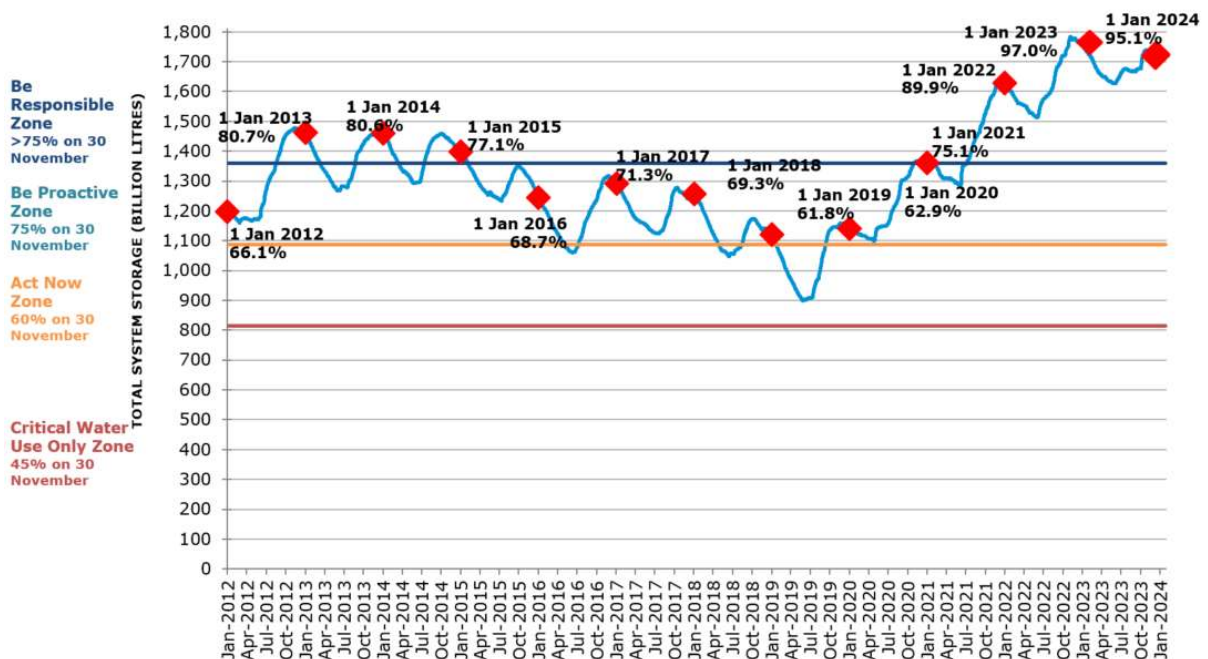


Figure 1: Historical water storage levels

13. Melbourne’s water storages have recovered from a recent low of 49.8% in June 2019 to 95.1% full (1,722 GL) as at 1 January 2024, with Thomson Reservoir, Melbourne’s largest storage, holding 1,057 GL (99% of its capacity).

14. Storage recovery has been due to higher than average rainfall and inflows into storages since 2020, the annual desalinated water orders placed since 2017 and ongoing water efficiency and conservation programs. In 2023,

the total annual inflow to storages was approximately 20% above the last 30-year average.

15. The decline in water storage volumes and water security for the greater Melbourne area prior to 2019 was driven by lower streamflow and increasing water demand.
16. Over the past ten years (2014-2023):
 - Average annual streamflow into Melbourne's four major harvesting storages (Thomson, Upper Yarra, O'Shannassy and Maroondah Reservoirs) have been approximately 517 GL/year. By comparison, the 5-year period of largest storage decline (2014-2018), had average annual streamflow of 395 GL/year which was only 5% higher than average annual streamflow during the 1997-2009 Millennium Drought (376 GL/year).
 - Population in Melbourne supplied by the three metropolitan water businesses has grown to a total of approximately 5 million people.
 - Average daily residential water use has remained stable from 162 litres per person per day in 2012/13 to 161 litres per person per day in 2022/23.
 - Due to population growth and additional supply needs to regional areas, Melbourne's water demand has grown by approximately 13%, from 399 GL/year in 2013/14 to 453 GL/year in 2022/23.

Melbourne's strategic water resource planning

17. In 2023, Melbourne Water and the metropolitan water businesses published the *Greater Melbourne Urban Water and System Strategy*, which presents a system view of water resource management across Melbourne and the surrounding region over the following 50 years. The strategy includes long-term water supply outlooks for streamflow scenarios described in the Department of Environment, Land, Water, and Planning (DELWP) *Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria*.
18. These long-term streamflow scenarios under climate change show that the reliable yield of the water supply system will continue to decline over time. Although storages are currently at higher levels, the reliable yield of the water supply system from the surface water catchments is expected to fall. The VDP will be increasingly important in providing water security for Melbourne and regional areas for a growing population and in managing the impacts of the changing and variable climate. The timing and severity of future extended drought sequences is uncertain, so preparedness for such events requires planning and operating the water supply system to maintain the buffer of water in storage that has been established in recent years, subject to pricing impacts.

Desalinated water order advice

19. The State of Victoria is required to place a desalinated water order with AquaSure by 1 April each year under the *Project Deed* between the two parties. Prior to this, the *Water Interface Agreement* between the Minister for Water, Melbourne Water, and the Secretary of DEECA requires Melbourne Water to provide the State of Victoria (represented by DEECA) with the following desalinated water order advice by 1 March:
- Its opinion of the volume of desalinated water required for the next financial year (i.e. 2024/25).
 - Its opinion of the constrained months² (if any) that it considers should be subject to a constrained month cap and the proposed volume of such caps.
 - A non-binding forecast of the quantity of desalinated water required for the next two financial years (i.e. 2025/26 and 2026/27).
20. Melbourne Water worked with the metropolitan water businesses, which hold the Bulk Entitlements to water from the VDP, to coordinate the process of consultation and deliver the modelling and technical analysis required to support the development of the 2024/25 desalinated water order advice. Other water entitlement holders across the water grid were also consulted to ensure the advice reflected forecast demands from the Melbourne system.

Water Outlook zones

21. The desalinated water order advice is a key annual planning activity for supporting the short and long-term water security for Melbourne and the surrounding region. The annual preparation of the advice follows the publication of the *Water Outlook* by Melbourne Water and the metropolitan water businesses on 1 December each year, and is linked to this process through the use of the Water Outlook zones in preparing the advice.
22. The metropolitan water businesses' Drought Preparedness Plans were reviewed in 2021 and specify a four-zone adaptive framework for monitoring water security based on the volume of water in Melbourne's storages on 30 November each year, as shown in Figure 2. As illustrated in Figure 1, the end of spring is typically when Melbourne's water storage volumes transition from filling during the cooler, wetter months, to falling during the warmer, drier months. Notable features of the framework are:
- A Water Outlook is published by 1 December each year by Melbourne Water and the metropolitan water businesses to document and

² Subject to conditions specified in the *Project Deed*, the State may specify the maximum volume of desalinated water which can be delivered (i.e. a constrained month cap) during the months of August, September, October and/or November.

communicate water security status and actions needed in the short to medium term with reference to the four-zone adaptive framework.

- When storages are in the Be Responsible Zone, storages are managed proactively for possible future drought events including ensuring water is used efficiently and drought response measures are identified.
- When storages are in the Be Proactive and Act Now Zone, actions are taken to ensure supply is available under severe and extended drought conditions for up to five years. Stages 1 and 2 of the metropolitan water businesses' water restrictions by-laws may also be used in these zones, although water restrictions can have significant social and economic impacts, so other approaches (e.g. voluntary water efficiency programs) may be implemented if similar reductions in water use can be achieved.
- Actions are taken to ensure water storages do not enter the Critical Water Use Only Zone except in extreme circumstances. Stages 3 and 4 of the metropolitan water businesses' water restriction by-laws are available to be used in such a severe event.
- Water may be ordered from the VDP in any of the four zones. The amount ordered is based on order advice provided by Melbourne Water and the metropolitan water businesses each year following detailed analysis that considers and balances the five principles and other factors (discussed below).
- In the development of the desalinated water order advice, the Water Outlook zones are used to measure potential future water security by comparing projections of future water storage levels against the four zones.

Community actions in this zone	Zones + Total Storage System (TSS)	Volume available for Greater Melbourne (GL)	Example water sector actions in this zone
<p>Continue using water efficiently: make every drop count and continue using water efficiently.</p>	<p>Be Responsible</p> <p>Equal to or greater than 75% TSS</p>	<p>Equal to or greater than 760 GL</p>	<ul style="list-style-type: none"> Optimise existing water sources Continue implementing water knowledge campaigns Develop plans to prepare for the 'Be Proactive' zone
<p>Reduce your water usage: make every drop count to avoid restrictions.</p>	<p>Be Proactive</p> <p>Less than 75% and equal to or greater than 60% TSS</p>	<p>Less than 760 GL and equal to or greater than 530 GL</p>	<ul style="list-style-type: none"> Increased use of desalination capacity Water knowledge campaigns for awareness and action Implement a voluntary demand reduction plan Develop plans for demand reduction in the 'Act Now' zone
<p>Minimise your water usage: water restrictions are possible.</p>	<p>Act Now</p> <p>Less than 60% and equal to or greater than 45% TSS</p>	<p>Less than 530 GL and equal to or greater than 300 GL</p>	<ul style="list-style-type: none"> Maximise use of desalination capacity Water knowledge campaigns for action required Implement demand reduction plan, including restrictions if necessary Develop plan for 'Emergency' zone
<p>Extreme water shortage: water restrictions to be applied.</p>	<p>Critical Water Use Only</p> <p>Less than 45% and equal to or greater than 25% TSS (minimum operating level)</p>	<p>Less than 300 GL and equal to or greater than 0 GL</p>	<ul style="list-style-type: none"> Maximise use of desalination capacity Water knowledge campaigns for action required Implement demand reduction plan, including restrictions Implement emergency supply options to meet restricted demand on an ongoing basis Use of Sugarloaf (North-South) Pipeline if storage at 30% or below on 1 November

Figure 2: Melbourne’s water outlook zones

23. The 2024 Water Outlook for Melbourne, published on 1 December 2023, noted that storages were in the Be Responsible Zone (95.0%) and secure for the coming year.

Principles

24. Consistent with the approach established by the water businesses and used in previous years, the 2024/25 desalinated water order advice is based around five principles. These were developed and assessed by the water businesses to balance the benefits of using the VDP in maintaining the short and long-term security of supply to customers against the costs of

placing an order and the potential for foregone water harvest³. Short-term water security is maintained by avoiding going into the Critical Water Use Only Zone, and minimising the risk of going into the Be Proactive Zone, while long-term water security is achieved by building storage recovery over a number of years when there is sufficient capacity available in the reservoirs and maintaining higher storage volumes, when storages volumes are high. The advice is based on the water businesses assessing an appropriate balance across these principles. The advice is prepared recognising that while the first year order is contractually binding for the financial year, there is the opportunity to revisit the volume required in each of the second and third years (non-binding advice), as part of the annual planning and ordering cycle. This allows adaptation based on the storage levels and outlooks at the time. The technical assessments of different potential desalinated water order volumes for 2024/25 described later in this document take this ability to adapt subsequent order volumes.

25. The intent of the principles is to provide for water security for Melbourne by avoiding both storages falling to low levels, and taking into account the potential for foregoing harvest of lower cost water from within the system in wetter years (although this can potentially provide environmental benefits for downstream waterways). In satisfying these, customer impacts should be minimised. The principles are:

- **Principle 1: Chance of storage volume falling into the Critical Water Use Only Zone**

Storages should remain above the Critical Water Use Only Zone described in the metropolitan water businesses' Drought Preparedness Plans on 30 November 2024, 30 November 2025 and 30 November 2026 under a severe drought sequence, which is defined as the driest sequence among the modelled streamflow sequences.

- **Principle 2: Chance of storage volume falling into the Be Proactive Zone**

Storages should remain above the Be Proactive Zone described in the metropolitan water businesses' Drought Preparedness Plans on 30 November 2024, 30 November 2025 and 30 November 2026 under 90 per cent of modelled streamflow sequences.

- **Principle 3: Storage Recovery**

Storages should display a recovery trend such that the median (50th percentile) modelled total system storage levels across the modelled streamflow sequences increase in 2024/25, 2025/26 and 2026/27.

- **Principle 4: Risk of desalinated water causing avoidable foregone harvest**

³ 'Foregone harvest' is defined as the modelled additional flow over dam spillways from the Melbourne water supply system and/or reduced harvest into Sugarloaf Reservoir for each modelled streamflow sequence due to the desalinated water order volumes supplied.

Foregone water harvest should be less than 12.5 GL/year for at least 50% of modelled streamflow sequences, and less than 25 GL/year for at least 90% of modelled streamflow sequences in 2024/25, 2025/26 and 2026/27. 'Foregone water harvest' is defined as the modelled additional flow over dam spillways from the Melbourne water supply reservoirs and/or reduced harvest into Sugarloaf Reservoir for each modelled streamflow sequence due to the desalinated water order volumes supplied. All water may not be harvested from smaller storages and weirs in wetter years.

- **Principle 5: Customer impacts**

The impacts on the metropolitan water businesses' customers' bills should be minimised while providing an acceptable security of supply.

26. Potential desalinated water order pathways were assessed against the five principles using detailed technical analysis described later in this report.

Technical analysis inputs and assumptions

Initial water storage levels

27. Water resource modelling for the 2024/25 advice examines possible future water storage levels for different desalinated water order volumes and operational conditions based on storage volumes observed on 30 November 2023 (1,722 GL or 95.0%). Approximately 166 GL of the water in storage on 1 December 2023 was allocated to entitlement holders other than the metropolitan water businesses, including the regional water businesses, the Victorian Environmental Water Holder, and Southern Rural Water. The distribution of water across the 10 major storage reservoirs in the Melbourne water supply system on 30th November 2023 is shown in Table 1. Water resource modelling supporting the desalinated water order advice considers the range of possible streamflow conditions into the reservoirs and the expected demands associated with all entitlement holders in the Melbourne system for the desalinated water order advice period.

Table 1: Distribution of water across the 10 major storage reservoirs in the Melbourne water supply system on 30th November 2023

Reservoir	Capacity at full supply (ML)	Volume (ML)	% Full
Thomson	1,068,000	1,055,233	98.8%
Upper Yarra	200,579	173,752	86.6%
O'Shannassy	3,123	3,192 ⁴	100%
Maroondah	22,179	21,227	95.7%
Sugarloaf	96,253	95,079	98.8%
Yan Yean	30,266	29,008	95.8%
Greenvale	26,839	23,279	86.7%
Silvan	40,445	35,461	87.7%
Cardinia	286,911	248,367	86.6%
Tarago	37,580	37,839 ⁴	100%
Total	1,812,175	1,722,437	95.0%

⁴ Reservoir was above capacity while water was flowing over the spillway.

Streamflow scenario

28. This technical analysis report was based on modelling with the 'Post-1997 step climate change' streamflow scenario described in the *2020 Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria*. The use of the 'Post-1997 step climate change' streamflow scenario is representative of streamflow conditions observed in recent history and therefore appropriate for developing the three year desalinated water order advice. The methodology used to establish this streamflow scenario results in consideration of some potential drought sequences more severe than those that have occurred historically.
29. The 'Post-1997 step climate change' adopts the observed streamflow from January 1913 to June 1997 scaled to match the statistical properties of the period July 1997 to December 2023. The 2023 streamflow at Melbourne's four major harvesting reservoirs was 578 GL. The addition of this year to the dataset has resulted in an increase of the average annual streamflow for the post-1997 climate scenario used as the baseline for assessment purposes by 4.8 GL/year. The difference between the observed historical streamflow (grey bars) and the adjusted streamflow (orange bars) are illustrated in Figure 3. In the water resource modelling, the 111 years of streamflow data, representing post-1997 step climate change, are used to create 111 streamflow replicates (also referred to as streamflow sequences), that are used to assess the performance of potential desalinated water order pathways against a range of potential streamflow conditions.

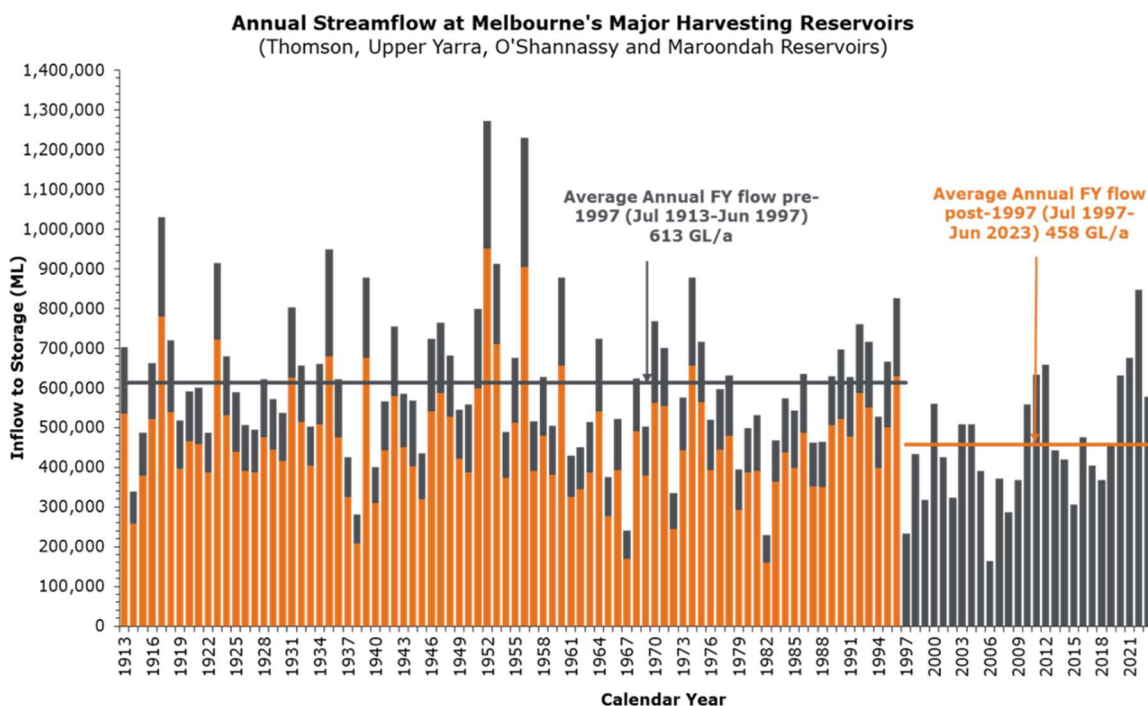


Figure 3: 'Post-1997 step climate change' streamflow scenario

Demand forecasts

30. To support the desalinated water order advice development process, the metropolitan and regional water businesses provided demand forecasts for the next 15 years. Focusing on the first three years covered by the advice, the demand forecasts are outlined in Table 2. These demand forecasts include expected water savings from the Target 155 program and Permanent Water Use Rules. In the water resources modelling, the metropolitan demand forecasts are adjusted in each modelled year using a climate index algorithm to reflect the variability in demand typically observed in warmer and drier years, cooler and wetter years and seasonal variability in demand during the year. The average annual demand forecasts for the metropolitan water businesses outlined in Table 2 reflect the impact of recent and forecast growth in Melbourne's population.

Table 2: Demand forecasts provided by the metropolitan and regional water businesses

Year	Metropolitan water businesses (GL)	Regional water businesses (GL)	Total (GL)
2024/25	445	23	469
2025/26	452	37	489
2026/27	455	33	488

31. The water demand forecasts in Table 2 do not include environmental water releases from water entitlements held by the Victorian Environmental Water Holder for the Yarra, Tarago and Thomson basins. For modelling purposes, it was assumed that the Victorian Environmental Water Holder will use 2023/24 planned releases and the annual allocation each year thereafter. The environmental allocations for key modelled river systems include:

- Yarra River system: 17 GL/year
- Thomson River system: 10 GL/year plus 3.9% of inflows to Thomson Reservoir (under the 'Post-1997 step climate change' streamflow scenario, 3.9% of inflows to Thomson Reservoir is approximately 7 GL/year on average).
- Tarago River system: 10.3% of inflows to Tarago Reservoir

32. The water demand forecasts in Table 2 also do not include rural irrigation water releases from water entitlements held by Southern Rural Water. For modelling purposes, it is assumed that Southern Rural Water uses their water entitlement of 6% of inflows to Thomson Reservoir each year (under

the 'Post-1997 step climate change' streamflow scenario, 6% of inflows to Thomson Reservoir is approximately 11 GL/year on average).

Operational considerations

33. The technical analysis supporting the 2024/25 desalinated water order advice also takes into account planned asset and operational factors including:
- **Cardinia Reservoir:** The modelling includes a maximum operating volume of 265 GL (full supply level approximately 287 GL), consistent with dam management operating conditions and also includes assumptions for temporary drawdown to 208 GL to support future capital works currently planned to commence in July 2025. Cardinia Reservoir is required to store desalinated water delivered as well as wet season streamflow from the upper Yarra River tributaries.
 - **Upper Yarra Reservoir:** The modelling includes a maximum operating volume of 185 GL (full supply level approximately 200 GL), consistent with system management rules.
 - **Yan Yean Reservoir:** Modelling takes into account the completion of the Yan Yean Reservoir water treatment plant upgrades and supply from Yan Yean Reservoir no earlier than July 2024.
34. Desalinated water orders are modelled assuming delivery from 1 July at the VDP's maximum capacity until the order has been completed. For larger orders, a reduced output from the VDP is assumed in February.

Cost information

35. To support water resource modelling and price modelling, DEECA provided estimates of costs associated with each of the desalinated water order volume options based on the best available information.

Technical analysis results

36. Water resource modelling was undertaken to support the 2024/25 desalinated water order advice, which provides an outlook from 1 December 2023 to 30 June 2027, covering the three financial years for which advice is required under the *Water Interface Agreement*. This modelling process considers all possible desalinated water orders that could be placed under the *Project Deed* during this three year period (including 0 GL), and identifies the desalinated water orders most likely to lead to outcomes consistent with the principles described in paragraph 22.

37. The water resources modelling separately considers each of the seven possible orders from 0 to 150 GL⁵ in the first year of the three-year desalinated water order advice. For each of these seven possible first year (2024/25) orders, Melbourne's water supply system is modelled over the next three and a half years under 111 different streamflow sequences. For each streamflow sequence, the model selects the second (2025/26) and third year (2026/27) desalinated water orders that best meet the five principles under that particular sequence.
38. The water resources modelling results are summarised in Table 3. These results reflect, for a given 2024/25 desalinated water order volume, the remaining risks after taking into account the potential to increase or decrease desalinated water orders in 2025/26 and 2026/27 in response to observed conditions.

⁵ The annual volumes that can be ordered are 0 GL, 15 GL, 50 GL, 75 GL, 100 GL, 125 GL and 150 GL as documented in the Victorian Desalination Project Deed

Table 3: Summary of assessment against the five principles for all potential 2024/25 desalinated water order volumes

2024/25 desalinated water order volume (GL)	Principle 1			Principle 2			Principle 4			Principle 3			Principle 5							
	Percentage of streamflow replicates that fall into the Critical Water Use Only Zone (below 45% on 30 November)			Percentage of streamflow replicates that fall into the Be Proactive Zone (below 75% on 30 November)			10th percentile foregone harvest (90% of streamflow replicates have foregone harvest less than this volume) (GL)			50th percentile (median) foregone harvest (50% of streamflow replicates have foregone harvest less than this volume) (GL)			50th percentile (median) storage recovery (50% of streamflow replicates have greater storage recovery than this volume) (GL)			Average discounted cost of producing desalinated water over the three year outlook period (\$M)		Average order volume across all streamflow replicates (GL)		Average change in order volume between years across all streamflow replicates
	Principle target: 0%			Principle target: Less than 10%			Principle target: Less than 25 GL			Principle target: Less than 12.5 GL			Principle target: More than 0 GL			Principle target: Minimise impacts (magnitude and variability) on customer bills in all three years				
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	All three years	Year 2	Year 3	All three years	
0 GL	0	0	0	3	7	6	0	8	12	0	0	4	-72	-33	-3	100	59	83	40	
15 GL	0	0	0	2	6	6	16	10	12	5	1	2	-66	-40	-18	88	49	59	36	
50 GL	0	0	0	1	5	5	38	29	12	18	3	1	-44	-57	-39	78	31	36	43	
75 GL	0	0	0	0	3	5	52	43	21	25	5	1	-25	-76	-39	86	25	28	55	
100 GL	0	0	0	0	3	5	55	61	23	31	8	2	-3	-88	-39	101	22	28	69	
125 GL	0	0	0	0	3	5	55	84	36	32	14	3	22	-104	-48	117	20	27	84	
150 GL	0	0	0	0	1	4	58	109	38	32	29	5	47	-116	-59	133	17	25	99	

39. Table 3 suggests that:

- **Principle 1 - Avoid being in the Critical Water Use Only Zone:** For all water order options in 2024/25, including a zero order, the assessed risk of storages falling into the Critical Water Use Only Zone on 30 November is 0% in all three years of the advice period.
- **Principle 2 – Minimise risk of being in the Be Proactive Zone:** For all water order options in 2024/25, including a zero order, the assessed risk of storages falling into the Be Proactive Zone on 30 November is below 10% in all three years of the advice period.
- **Principle 3 – Maximise storage recovery:** At least 125 GL is required in 2024/25 to achieve a 50% chance of storages being maintained in 2024/25.
- **Principle 4 – Minimise foregone harvest:** An order of 0 GL will maintain foregone harvest within benchmarks in all three years of the advice period. An order of 15 GL does not exceed the foregone harvest benchmark, however there is a risk of foregoing more catchment harvest than the order volume. Orders of 50 GL and above provide unacceptable foregone harvest risk well above the principle criteria.
- **Principle 5 – Minimise customers’ bill impacts:** A 0 GL has no impact to customer bills in 2024/25 while a 15 GL order has a slight increase. With lower water orders in 2024/25 and the anticipated higher orders associated with the forecast non-binding advice of 50 GL and 75 GL, customer bills may be affected in subsequent years.

40. Figure 4 illustrates a range of potential future water storage levels over the next three financial years for the 111 streamflow sequences. Figure 4 assumes that 0 GL is ordered in 2024/25, followed by orders in 2025/26 and 2026/27 adapted for each streamflow sequence as per paragraph 34.

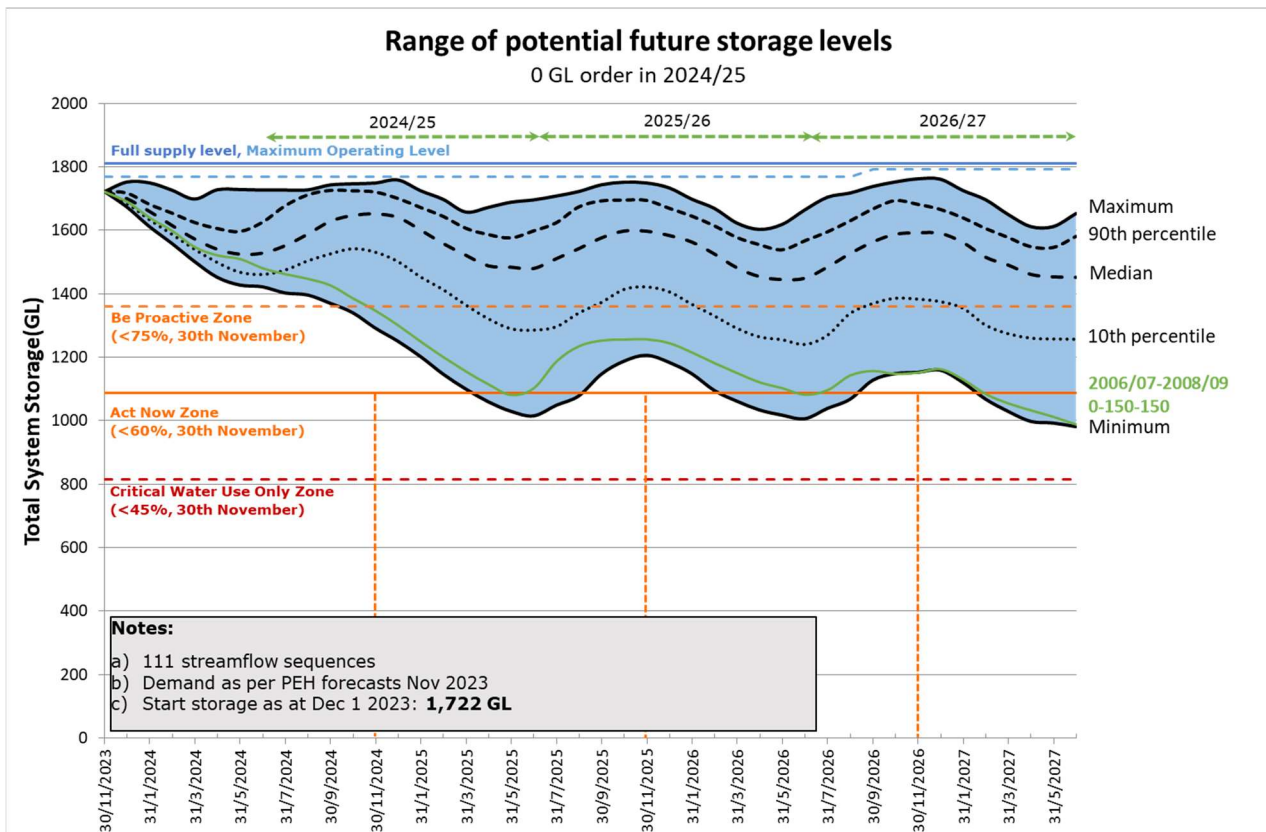


Figure 4: Modelled projection of potential future water storage levels assuming a 0 GL order in 2024/25

41. The green line in Figure 4 shows the projected water storage levels for a particularly dry sequence (2006/07, 2007/08 and 2008/09) occurs again. For this particular streamflow sequence, the modelling suggests that it could be appropriate to order 150 GL in both 2025/26 and 2026/27 to respond to falling water storage levels resulting from severe dry conditions.

Other considerations

Value of Water in Storage

42. While higher inflow conditions have occurred over the years 2020-2023, in the medium to long term, water supply system yield is projected to decrease as a result of changing climate conditions while demand is projected to continue to increase. As a result:

- Water storage levels will, on average, show a decreasing trend without regular water volumes provided by the VDP.
- Desalinated water order volumes will therefore be necessary in order to maintain or recover storage levels. Depending on the sequencing of future wet and dry years, average orders will reflect an increasing use of the VDP.

- Prior to the VDP's full capacity being regularly required to supply growing demand in future, larger orders when there is storage capacity can be used to build a buffer of water in storage for drought resilience.
- Maintaining high storage volumes increases the resilience of Melbourne's and the surrounding region's resilience to extreme climate events such as droughts, reduces the severity and impact of water restrictions and can assist in delaying the need for augmentation.
- Augmentation to the water supply system will become necessary as the difference between water demand and yield diminishes and water security cannot be maintained.

Reservoir spillway flows

43. Given current high water storage volumes and the distribution of water across the major water storages, Principle 4, the risk of desalinated water causing avoidable foregone harvest and reservoir spills, was a key consideration in the technical analysis. In most years, some spillway flows occur from the smaller reservoirs in the system regardless of any desalinated water orders.
44. The 2024/25 order advice gave detailed consideration to order volumes that balanced maintaining drought reserves in Thomson Reservoir while managing the possible risk of the reservoir reaching full capacity and spilling again in 2024/25. Analysis highlighted that there is potential of spillway flows from Thomson Reservoir in 2024/25; placing any desalinated water order in 2023/24 increases this possibility.

Climate outlooks

45. The desalinated water order advice was informed by the Bureau of Meteorology's seasonal streamflow forecasts and ENSO Wrap-up issued during January and February 2024.
 - The Climate Driver Update (issued 23 January 2024) indicated that:
 - 'El Niño continues in the tropical Pacific Ocean. Model forecasts and observations indicate sea surface temperatures in the central tropical Pacific have peaked and are now declining. Sea surface temperatures in the tropical Pacific are expected to return to neutral El Niño–Southern Oscillation (ENSO) levels in the southern hemisphere autumn 2024.'
 - 'The typical drying influence of El Niño on Australia's climate usually reduces during summer, especially in the east; however, below median rainfall is still often observed in north-east Australia. As we have seen this year and through historical data, high-impact rainfall events can occur during El Niño years, particularly during October to April when severe storm frequency peaks.'
 - 'The Southern Annular Mode (SAM) is currently positive. It is expected to weaken to neutral levels over the coming fortnight. SAM has been

positive for much of December and January. During summer, positive SAM increases the chance of above average rainfall for parts of eastern NSW, south-eastern Queensland, eastern Victoria, and north-eastern Tasmania, but increases the chance of below average rainfall for western Tasmania.'

- 'The positive Indian Ocean Dipole (IOD) event has weakened from the strong values seen in late 2023. IOD events typically breakdown as the monsoon trough shifts south into the southern hemisphere.'
- The seasonal streamflow forecasts for Melbourne's four major harvesting storages (issued mid-January 2024 and illustrated in Table 4) generally favoured median to high flow for the period January to March 2024.

4 major harvesting reservoirs	Jan – Mar 2024 <small>(based on 'unpublished new' forecast provided by BoM)</small>
Thomson	High flow
Upper Yarra	Low flow
O'Shannassy	Median flow
Maroondah <small>(Watts River & Graceburn Creek)</small>	Median flow

Table 4: Seasonal streamflow forecast for Melbourne's four major harvesting storages for January to March 2024 (Source: Australian Government Bureau of Meteorology)

46. More generally, the Bureau of Meteorology climate outlooks issued on 9 February 2023 indicated for the period March to May 2023, in Melbourne, approximately:
 - 55-60% chance of exceeding median rainfall.
 - 55-70% chance of exceeding median maximum temperature.
47. These outlooks do not extend over the three years of the desalinated water order advice period, but indicate relatively short term conditions. While an El Niño event remains active in early 2024, the streamflow and rainfall forecasts show mixed signals and as such have not influenced the advice for 2024/25.

Technical outcomes

48. Order volumes of 0 GL and 15 GL were considered for the 2024/25 desalinated water order advice. These options provided water security by managing the risk of entering the Critical Water Use Only and Be Proactive

Zones, minimised foregone harvest and major reservoirs reaching capacity and maintains a buffer against the impacts of future drought. These two potential order volumes meet most of the desalinated water order advice principles in 2024/25.

49. A 0 GL order does not impact customer bills while a 15 GL order results in small customer bill increases from 2023/24 to 2024/25.
50. To best balance the need to manage the risk of foregone harvest while maintaining a storage buffer, desalinated water order advice of 0 GL for 2024/25 is most aligned with the desalination order advice principles. Thereafter, non-binding forecasts of 50 GL in 2025/26 and 75 GL in 2026/27 are recommended based on average order volumes across the modelling replicates.

Conclusion

51. Consistent with the requirements of the *Water Interface Agreement* described in paragraph 19, the following desalinated water order advice has been provided by Melbourne Water to the Victorian Government:
 - a. The required annual water volume for the 2024/25 supply period should be 0 GL.
 - b. There are no constrained months in the 2024/25 supply period.
 - c. Non-binding forecasts of 50 GL in 2025/26 and 75 GL in 2026/27 supply periods are appropriate.